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GB-1954-02

703,811 COMPLETE SPECIFICATION

1 SHEET

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Fig. 1

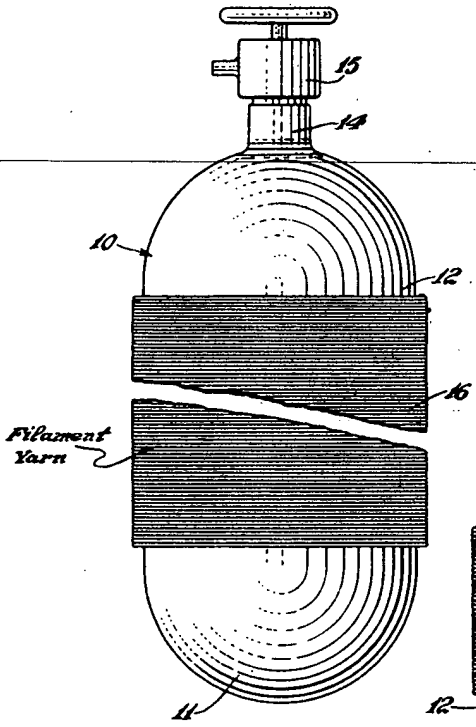


Fig. 2

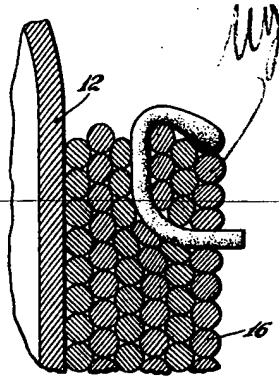
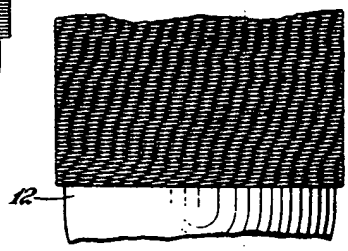


Fig. 3



220/589

PATENT SPECIFICATION

703,811

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No. 1666/52.

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Complete Specification Published Feb. 10, 1954.

Index at acceptance :—Class 8(2), G1B5B2.

COMPLETE SPECIFICATION

Improvements in or relating to High Pressure Fluid Containers

We, SPECIALTIES DEVELOPMENT CORPORATION, a Corporation organized and existing under the laws of the State of New Jersey, located at 675, Main Street, Belleville 9, State of New Jersey, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to containers, such as cylinders, for storing fluid medium under relatively high pressure.

In the Specification of British Patent No. 556,801, a cylindrical container is disclosed which is constructed to withstand the highest working pressures at which the fluid medium may be confined therein under normal conditions of use, but which is inherently subject to ripping apart, for example when pierced by a projectile, while so confining the medium. This contingency is guarded against by applying a wire winding which serves to minimize and localize the area of rupture of the container.

When this type container is pierced by a projectile, a number of convolutions of the wire winding are severed at the entrance and exit holes formed by the projectile and become separated from the winding. While provision is made for causing such severed convolutions to embrace the container in clasping relation, it has been found that, in some instances, fragments of the severed portion of the winding are projected in the vicinity of the container with such violence that they are capable of causing injury to persons nearby.

Accordingly, an object of the present invention is to eliminate the foregoing hazard.

Another object is to provide a winding which is even more effective in minimizing and localizing the area of rupture of the container than the windings used heretofore.

A further object is to provide a simple, inexpensive winding which is readily applied to containers in a more efficient manner.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

The present invention consists in a container for storing liquid medium under high pressure comprising a shell adapted to withstand the highest working pressure at which the fluid may be confined therein under normal conditions of use without further reinforcement, but which is inherently subject to ripping apart when pierced by a projectile; and a winding of multifilament yarn applied onto and surrounding said wall and secured thereon, said yarn filaments being formed of material having substantially the tensile and elongation properties of nylon yarn in that it has a relatively high tensile strength-for-weight ratio and has the ability to be elongated between about 14% and about 25% when stretched under tension, said yarn being applied about said wall in substantially unstretched condition and in no case exceeding 25% of its ultimate elongation, whereby said yarn can be elongated substantially when stretched under the influence of the expansion of said container wall upon the wall being pierced by a projectile, while retaining sufficient strength to prevent ripping apart of said wall and to thereby minimize and localize the area of rupture of said wall.

As illustrated in the embodiment about to be described in detail, the winding may comprise a plurality of continuous layers of yarn either open or close wound, pre-

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ferably in substantially unstretched condition or not exceeding 25% of its ultimate elongation. When such a winding is severed by a projectile, the freed or separated fragments thereof, by reason of their low mass, are not projected with violence, whereby damage or injury is averted. By reason of the highly elastic but high strength characteristics of the winding material, the winding is capable of yielding at the zones adjacent the entrance and exit holes formed by the projectile in the container and is pushed aside by the projectile without being severed. Also, by reason of the foregoing characteristics the winding provides a shock absorber effect for the container at the zones adjacent the holes pierced therein. This is attributed to the stretching of the winding without breaking of the unsevered convolutions of yarn, whereby the forces of the projectile and the fluid medium rushing out of the holes which tend to tear the zone of the container surrounding the holes outwardly, are yieldingly resisted until they subside. Consequently, the area at which fragmentation or rupture may occur is greatly minimized and localized.

A preferred embodiment of the invention has been chosen for purposes of illustration and description, and is shown in the accompanying drawing, forming a part of the specification, wherein:—

Figure 1 is a fragmentary elevational view of a container for high pressure fluid media provided with a winding in accordance with the present invention, the winding being close wound with adjacent convolutions thereof contiguously disposed.

Figure 2 is a fragmentary sectional view of the winding illustrating one manner of securing a free end thereof.

Figure 3 is a fragmentary elevational view illustrating an open wound winding on the container.

Referring to the drawing in detail and more particularly to Figure 1 thereof, there is shown, by way of example a conventional metallic container 10 for storing fluid medium under pressure such as compressed and/or liquefied normally gaseous materials. The container comprises a closed end 11, a cylindrical wall 12, and a neck or outlet spud 14 opposite the closed end to which a discharge control device 15 is secured. This container is constructed of suitable material of a thickness to withstand a pressure higher than the normal operating pressure, and is in accordance with the acceptance standards such as those of the Department of Scientific and Industrial Research (Gas Cylinder Research Comittee). Such containers are generally referred to as high pressure cylinders.

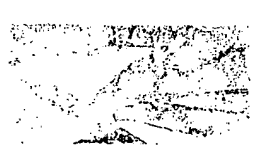
In accordance with the present invention, the wall 12 is surrounded by a winding 16 of filament yarn. Such yarn is composed of a number of relatively fine practically continuous filaments grouped together and usually given a slight twist. The individual filaments are strands of indefinite length, and, compared to staple fibres, are of extreme length and often may be measured in thousands of yards without a break.

The yarn utilized herein is composed of filaments formed of material such as nylon which has a tensile strength of between about 65000 and about 111,000 pounds per square inch, has an elongation (standard) of between about 14% and about 25%, and has a specific gravity of about 1.14. Nylon yarn, by reason of these properties, has a higher tensile strength-for-weight ratio than steel piano wire and has the ability to stretch substantially when tensioned without breaking. Steel piano wire does not have this last mentioned property, and has a specific gravity more than six times that of nylon whereby fragments of steel wire have considerable mass and can be projected violently upon being severed from a winding by gun fire or the like.

While the use of nylon filament yarn is preferred herein because of its relatively low cost and general availability, yarn composed of filaments formed of other materials may be used to good advantage. Examples of such other materials are viscose rayon of the high tenacity type, acrylic resins, vinyl resins, and silk. These materials have or closely approach the tensile and elongation properties of nylon and have tensile strength-for-weight ratios comparable to steel piano wire. Silk, however, has the disadvantage of being subject to dry rot and therefore should not be used when it is desired that the winding remains effective for long periods of time.

It will be apparent that filament yarns composed of two or more of these materials may be utilized.

In applying the winding 16 to the container 10, the container is mounted in suitable apparatus for effecting rotation of the container about its longitudinal axis; an end of yarn is looped and tied about the cylindrical wall 12, preferably adjacent one end thereof, or is arranged to apply the winding thereover; the container is rotated at a suitable speed; and the yarn is traversed or laid lengthwise about the surface of the wall 12 to be surrounded by the winding until a desired number of layers of yarn which have been



wound thereon. The yarn is then severed and the tail end thereof is secured to the winding in any suitable manner to prevent unravelling of the winding, for example, by positioning the tail end under convolutions of the winding.

This manner of applying the winding is highly advantageous because no special elements are required for anchoring the ends of the winding. Also, by reason of the flexibility and softness of the yarn formed of these materials, the yarn is readily furnished from a yarn package to the container on which it is wound and this can be applied at relatively high speeds.

In applying the winding, the yarn is wound at a relatively low tension so that it is applied to the container varying from practically unstretched condition to not more than 25% of its ultimate elongation. In this manner, the inherent elongation characteristic of the yarn is not impaired and can be utilized to great advantage when the container is subjected to gun fire or to the possibility of damage by flying fragments. Such low tension can be accurately maintained at a value of 1.5 ounces or less by suitable tension compensating and/or furnishing devices which are generally employed in the textile industry.

In Figures 1 and 2, the yarn is shown as being close wound with successive convolutions of each layer being contiguous to each other. Such a winding can be produced by rotating the yarn in a lathe having a screw feed for traversing the yarn.

In Figure 3, the yarn is shown as being open wound in the manner of a yarn package with convolutions of adjacent layers crossing at a substantial angle. Such a winding can be produced by apparatus equipped with a rapidly moving traverse mechanism of the type utilized in yarn package winders and the like. This manner of application of the yarn lends itself to high speed winding.

In order to illustrate a specific embodiment of the present invention by way of example, a container 10 of the type adapted to withstand the highest working pressure at which fluid medium may be normally confied therein was placed in a lathe; and six layers of 210 denier, 12 ply, about 3 twists per inch, approximately .020 of an inch diameter, nylon filament yarn were close wound on the container under 1.5 ounce tension in the manner hereinbefore described. This yarn was composed of 408 filaments of individual continuous strands, and produced a winding having a thickness of about .13 of an inch. The yarn had a tensile strength exceeding 100,000 pounds per inch and an elongation of about 20%.

The container having the winding thereon was equipped with a discharge control valve 15 and was filled with nitrogen under about 1800 pounds per inch pressure at about 70° F.

The container was securely mounted and was then tested by firing 50 caliber machine gun ammunition at the same from a point at a distance of about 150 feet. The projectile struck the container and passed therethrough approximately diametrically with respect to its longitudinal axis at a point at about the middle of the winding.

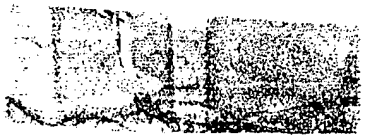
Upon inspection, it was found that the projectile severed the winding and pierced the container wall rather cleanly, when entering the container; and that the projectile, when leaving the container, formed a slightly larger and more ragged opening as is customary due to deformation of the nose of the projectile in piercing an entrance opening. Further inspection of the container and the winding revealed that a minimum of convolutions of the winding were severed at the entrance and exit openings and that the convolutions adjacent the openings were intact, there being some indication that such convolutions were stretched and pushed aside by the projectile without breaking the yarn. Also no fragmentation of the container wall took place at the openings: and ragged formations of the container wall surrounding the exit opening which ordinarily would induce fragmentation were confined by the winding. Convolutions of the winding which were severed at substantially diametrical points and were separated from the winding merely fell downwardly, and were not projected by the force of the projectile expended on the container.

It will be of course understood that number of layers of the yarn and the thickness thereof may be greatly varied depending upon the type of filament yarn material utilized and upon the caliber of the ammunition which must be withstood to prevent shattering or fragmentation of the container.

From the foregoing description, it will be seen that the present invention provides a container having a winding thereon which is readily applied at a low cost and is highly effective in rendering the container shatterproof when subjected, for example, to gun fire or to impact by missiles or flying fragments.

What we claim is:—

1. A container for storing liquid medium under high pressure comprising a shell adapted to withstand the highest



working pressure at which the fluid may be confined therein under normal conditions of use without further reinforcement, but which is inherently subject to ripping apart when pierced by a projectile; and a winding of multifilament yarn applied onto and surrounding said wall and secured thereon, said yarn filaments being formed of material having substantially the tensile and elongation properties of nylon yarn in that it has a relatively high tensile strength-for-weight ratio and has the ability to be elongated between about 14% and about 25% when stretched under tension, said yarn being applied about said wall in substantially unstretched condition and in no case exceeding 25% of its ultimate elongation, whereby said yarn can be elongated substantially when stretched under the influence of the expansion of said container wall upon the wall being pierced by a projectile, while retaining sufficient strength to prevent ripping apart of said wall and to thereby minimize and localize the area of rupture of said wall.

2. A container according to claim 1, wherein said winding is formed of a plurality of layers of contiguous convolutions of yarn.

3. A container according to claim 1 or claim 2, wherein said convolutions are substantially unstretched and can be stretched and pushed aside by the projectile whereby severance of the convolutions by the projectile is minimized and a greater number of convolutions remain intact adjacent the entrance and exit openings in said wall caused by the projectile.

4. A container for storing fluid under pressure as substantially described with reference to the accompanying drawings.

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